DE LA RECHERCHE À L'INDUSTRIE

Assembly of the cryomodules: overall organization

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Low Beta 650 MHz Cryomodule – Preliminary Design Review – March 10th, 2021

Organization means optimization

Known input:

- The chain of operations to be performed at CEA-Saclay
  - Reception and control of components
  - Assembly of cavity string in clean room (cf. S. Berry presentation)
  - Assembly of cryomodule in the halls (cf. S. Berry presentation)
  - System Acceptance Review 1 (leak checks, RF controls, etc..)
  - Cold RF test of cryomodule (cf. H. Jenhani presentation)
  - System Acceptance Review 2 (RF measurements, X-Ray, cryogenic heat loads, etc.)
  - Partial dis-assembly and preparation for shipment (transfer to frame, packaging of air-side couplers, top hat, etc.)
  - Transfer of Title CEA-DOE
- The assembly labour will be subcontracted
- The assembly will take place in the Hall n°124, formerly XFEL string+cold mass assembly, currently ESS complete cryomodule assembly

Partially understood input:

- Cold RF test plan, and testing duration
- Title Transfer duration
- Storage and cryomodule parking areas

If only for financial reasons, we need to optimize this **chain of operations (from reception to shipment)** to reach an objective of throughput (currently, one month) and minimize lag times and idle labour times.

Organisation means optimisation

Scenarios:

- We believe that the assembly of each cryomodule can be done in 3 months (about 65 working days), broken-down over a minimum of 3 workstations (including the clean room) to allow the assembly of three cryomodules in parallel.
- Therefore an assembly throughput of one month is achievable (goal of ESS for assembly of 30 CMs), which is represented in our current schedule
- **Cold RF testing cycle of one month is challenging**. We are working with Fermilab on a thorough understanding of the RF Test Plan. Experience with ESS CM tests is already used for evaluating vacuum and cryogenic times. Experience HB650 pCM will be essential.
- Title Transfer to DOE can start only after the formal SAR2 acceptance by Fermilab, evaluated to last about 4 weeks. Assuming that dis-assembly of couplers and cryogenics top hat, we need define parking and storage areas to minimize the risk of mishandling of the cryomodules during that time (up to one month).
- The current ESS storage building (formerly XFEL shipment area) is perfectly suited, and hopefully available.

Concluding Remarks

Summary

- **It is too early to make fundamental decisions about the organization and implantation of the assembly and storage infrastructure.**
- **RF testing duration is identified as the bottleneck for CM production-chain throughput**
- **Clean room organization and tooling, with the goal of 1 string/month, can go ahead independently.**
- **Most of the CM assembly tooling design and fabrication can also go ahead, once details are understood.**